8.4 Geological Hazards and Resources

This section evaluates the effect of geological hazards on the project and of the project on geological resources of commercial, recreational, or scientific value. Section 8.4.1 describes the existing environment that could be affected, including regional and local geology and geological hazards. Section 8.4.2 identifies potential environmental effects from project development. Section 8.4.3 discusses cumulative effects. Section 8.4.4 presents mitigation measures. Section 8.4.5 presents the laws, ordinances, regulations, and standards (LORS) applicable to geological hazards and resources. Section 8.4.6 describes the required permits and provides agency contacts. Section 8.4.7 provides the references used to develop this section.

8.4.1 Affected Environment

The Sun Valley Energy Project (SVEP) is located in Riverside County on an approximately 23-acre parcel on Matthews Road, Romoland, California. The SVEP site is currently a vacant lot that is relatively flat and lies within the Perris Valley in the northern part of the Peninsular Ranges physiographic province. The site elevation is approximately 1,500 feet above mean sea level. The site is underlain by Quaternary alluvial sediments and older mostly marine sediments. A site-specific geotechnical investigation has been conducted for this project and was used in the development of this analysis. A copy of the report is included as an attachment to Appendix 10G.

8.4.1.1 Regional Geology

The geology of the site vicinity is complex, largely a result of the interaction of the strike-slip tectonics of the San Andreas Fault Zone system and the compressional tectonics of the Peninsular Ranges. The site lies within the northern part of Peninsular Ranges. The Peninsular Ranges are characterized as being somewhat similar to the Sierra Nevada in that each range has a gentle western and steep eastern slope. The western sides typically have discrete blocks that slope progressively lower to the west produced by major fault zones (Norris and Webb, 1990).

Within the province, the project site lies in the Perris Valley, which is in the central part of the Perris Block. The Perris Block is a stable structural block of crystalline basement rock bounded by the Cucamonga fault, San Gabriel Mountains, and San Jacinto Fault zone. The San Jacinto Fault Zone is a major southern California fault zone and lies to the northeast (approximately 13 miles). In addition, the San Andreas and Elsinore fault zones are seismically active major faults in the project vicinity.

Southern California, including this site, is within a highly active seismic region. The numerous active and potentially active faults considered capable of generating earthquakes have caused and will continue to cause seismic shaking in the project area. Over 20 faults are present within a 62-mile (100-kilometer) radius of the site.

8.4.1.2 Local Geology

The project site lies on a relatively flat Quaternary alluvial surface derived from adjacent uplands. To the northwest is Double Butte and to the south is an unnamed hill. Each of these local uplands is comprised of mostly granitic bedrock outcrops (Morton, 1996). Alluvial material at the site includes gravel, sands, and finer-grained silts and clays (Morton, 1993). The surficial geology within a 2-mile radius of the site is presented on Figure 8.4-1.

8.4.1.3 Faulting

Southern California is a region with numerous faults dominated by the tectonics of American and Pacific Plates. Many faults are present in the region around the site. Most significantly, the San Andreas Fault Zone along with other northwest-trending strike slip faults, including the San Jacinto fault and the Whittier-Elsinore faults, are present in the vicinity that could affect the project site area. The significant faults in the site vicinity are described below and are shown on Figure 8.4-2. The site does not lie within or near an Alquist-Priolo Earthquake Fault Zone (Jennings, 1994).

8.4.1.3.1 San Jacinto Fault

Approximately 10 miles to the northeast of the site is the San Jacinto Fault. This fault is mapped as an Alquist-Priolo Zone fault (Jennings, 1994). More large historic earthquakes have occurred on this fault than any other fault in Southern California (CHJ, 2005). Maximum moment magnitude for the segment of this fault nearest the project site is 6.9 (URS Corp., 2000).

8.4.1.3.2 San Andreas Fault Zone

The San Andreas Fault Zone lies approximately 25 miles northeast of the site. This fault is the largest active fault in California and extends from the Gulf of California to Cape Mendocino in northern California. The segment of the fault that is closest to the site has exhibited Holocene displacement and is shown as an Alquist-Priolo Zone (Jennings, 1994). Maximum moment magnitude for this section of the fault is 7.4 (URS Corp., 2000). Given the distance to the site, this fault is likely the dominant seismic hazard to the site.

8.4.1.3.3 Elsinore Fault

The trace of the Elsinore fault is located approximately 10 miles southwest of the site. This fault is composed of multiple *en-echelon* and diverging fault traces and splays into the Whittier and Chino faults to the north (CHJ, 2005). The Elsinore fault is depicted as an Alquist-Priolo Zone fault with Holocene surface rupture events (Jennings, 1994) and has a maximum moment magnitude of 6.8 (URS Corp., 2000).

8.4.1.4 Geological Hazards

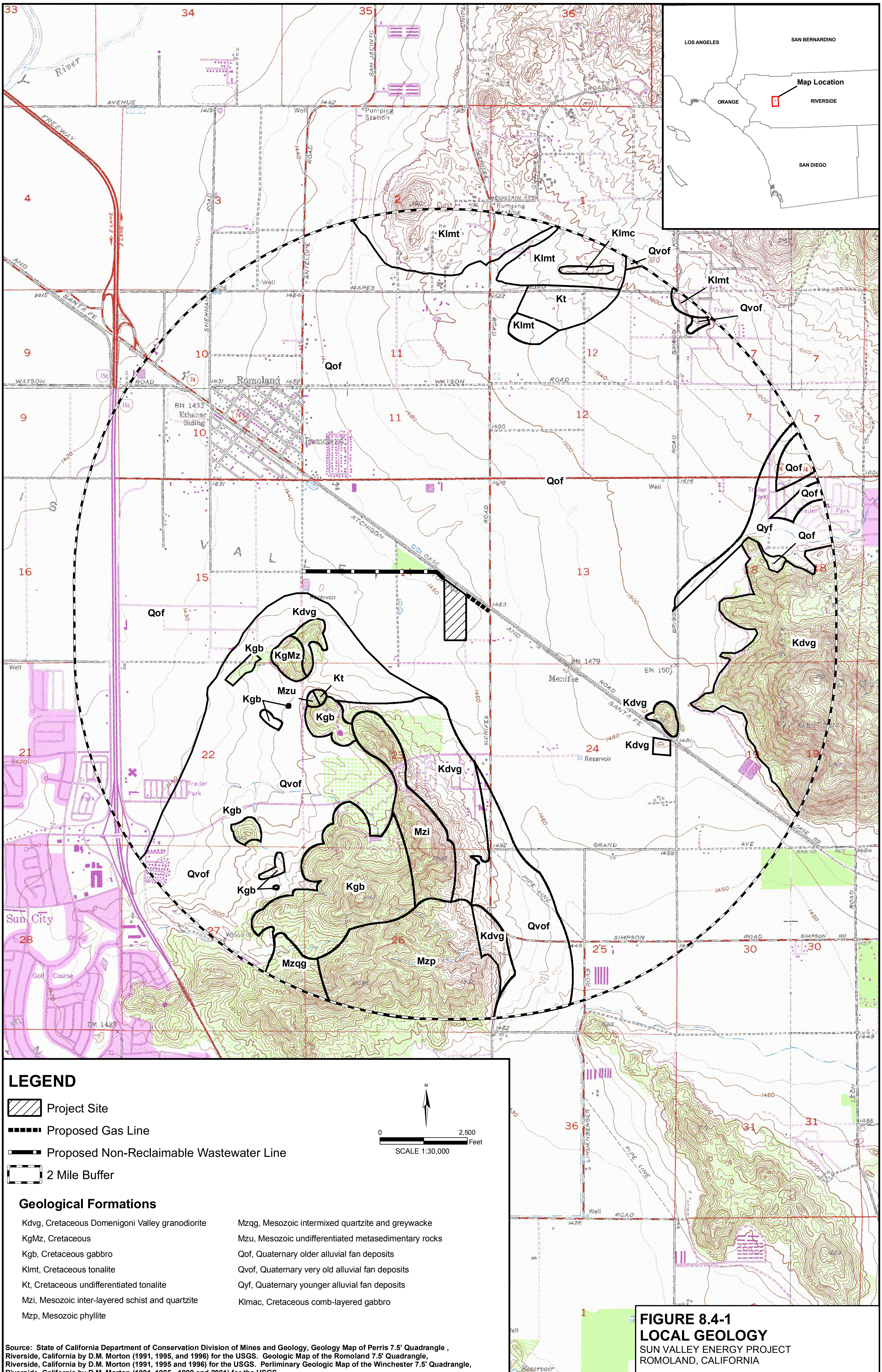
The following sections discuss the potential geological hazards that might occur in the project area.

8.4.1.4.1 Ground Rupture

Ground rupture is caused when an earthquake event along a fault creates rupture at the surface. Because no known faults exist at the project site, the likelihood of ground rupture to occur at the project site is low.

8.4.1.4.2 Seismic Shaking

Seismic waves passing through earth material during an earthquake cause the ground to shake. Severe ground shaking is the most widespread and destructive aspect of earthquakes and the degree of ground shaking is based on distance from earthquake epicenter, magnitude



Source: State of California Department of Conservation Division of Mines and Geology, Geology Map of Perris 7.5' Quadrangle , Riverside, California by D.M. Morton (1991, 1995, and 1996) for the USGS. Geologic Map of the Romoland 7.5' Quadrangle, Riverside, California by D.M. Morton (1991, 1995 and 1996) for the USGS. Perliminary Geologic Map of the Winchester 7.5' Quadrangle, Riverside, California by D.M. Morton (1991, 1995 - 1999 and 2001) for the USGS.

FIGURE 8.4-1
LOCAL GEOLOGY
SUN VALLEY ENERGY PROJECT
ROMOLAND, CALIFORNIA

SAC \\GLACIER\SACGIS\SUNVALLEY_CCEP\SOURCEDATA\MXDS\GEOLOGYMAP.MXD GEOLOGYMAP 11/16/2005 16:04:02

CH2MHILL

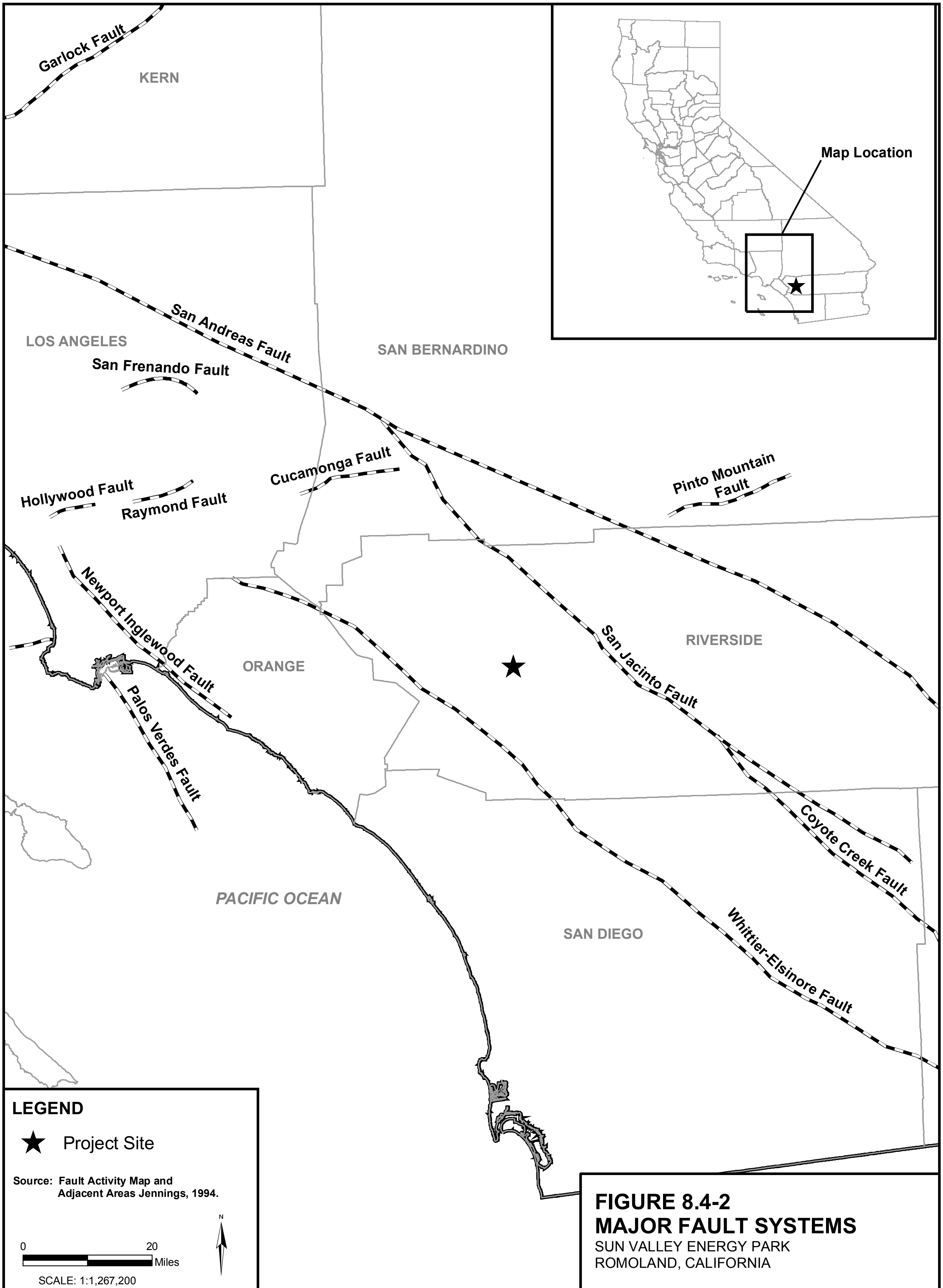


FIGURE 8.4-2
MAJOR FAULT SYSTEMS
SUN VALLEY ENERGY PARK
ROMOLAND, CALIFORNIA

CH2MHILL

of the earthquake, site-specific soil types, among other factors. Southern California has experienced strong ground motion in the past and will do so in the future. The site is located in Seismic Zone 4, according to the 2001 California Building Code (CBC). A Seismic Zone Factor "Z" of 0.40 is assigned to Seismic Zone 4 (CHJ, 2005). According to the site-specific geotechnical study conducted for the SVEP, the estimated peak horizontal ground acceleration with a 10 percent probability of exceedance in 50 years is 0.41g (CHJ, 2005).

8.4.1.4.3 Liquefaction

During strong ground-shaking, loose, saturated, cohesion-less soils can experience a temporary loss of shear strength and act as a fluid. This phenomenon is known as liquefaction. Liquefaction is dependent on depth to water, grain size distribution, relative density of the soils, degree of saturation, and intensity and duration of the earthquake. The potential hazard associated with liquefaction is seismically induced settlement. The depth to groundwater at the project site is relatively deep, approximately 60 to 80 feet, and the soil types generally consist of medium dense to dense fine to medium silty sands. In the northern part of the site, fine-grained sandy clays were present. The units present at SVEP are not considered to be susceptible to liquefaction (CHJ, 2005). Therefore, the likelihood that liquefaction will occur is negligible.

8.4.1.4.4 Mass Wasting

Mass wasting depends on steepness of the slope, underlying geology, surface soil strength, and moisture in the soil. Significant excavating, grading, or fill work during construction might introduce mass wasting hazards at the project site. Because the site is relatively flat and no significant excavation is planned during site construction, the potential for direct impact from mass wasting at the site is considered low to negligible.

8.4.1.4.5 Subsidence

Subsidence can be a natural or man-made phenomenon resulting from tectonic movement, consolidation, fluid removal (oil, gas, or water), or rapid sedimentation or oxidation of organic-rich soil. Organic soils with significant collapse potential were not encountered during the geotechnical investigation. The potential for subsidence, as a hazard that could affect the project site, is low (CHJ, 2005).

8.4.1.4.6 Expansive Soils

Expansive soils shrink and swell with wetting and drying. The shrink-swell capacity of expansive soils can result in differential movement beneath foundations. Soil present at the site predominately consists of sandy loam derived from granitic materials. The sandy loam exhibits a low shrink-swell potential (USDA, 1971). According to the geotechnical report, an expansion test on site soils revealed a "low" to borderline "medium" potential for expansion and that special provisions should be made to safe guard against potential damage due to this expansion index (CHJ, 2005).

8.4.1.5 Geological Resources of Recreational, Commercial, or Scientific Value

Geological resources of recreational, commercial, or scientific value in the project vicinity that could be affected include commercially accessible sand and gravel, decomposed granite, and clay deposits. There are no known geological resources that provide a significant scientific or recreational value in the vicinity of the site. According to the maps of the State of California Division of Oil, Gas and Geothermal Resources (CDOGGR, 2005), there are no oil or gas reserves in the project vicinity. Geological resources in the vicinity of the project site include several mining operations to the west of the project site near the City of Corona (URS, 2001); however, and none of these are located within two miles of the project site.

8.4.2 Environmental Consequences

The potential environmental effects from construction and operation of the SVEP on geological resources and risks to life and property from geological hazards are presented in the following sections.

8.4.2.1 Significance Criteria

According to Appendix G of CEQA, the project would have a significant environmental impact in terms of geological hazards and resources if it would do the following:

- Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:
- Rupture of a known earthquake fault (Alquist-Priolo fault zone)
- Strong seismic ground shaking
- Seismic-related ground failure, including liquefaction
- Be located on a geological unit or soil that is unstable or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse
- Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state
- Result in the loss of availability of a locally important mineral resource recovery site delineated on a local plan, specific plan, or other land use plan

8.4.2.2 Geological Hazards

There is significant potential for seismic ground shaking to affect the plant site in the event of a large magnitude earthquake occurring on fault segments located near the project. The project, however, is not located within an Alquist-Priolo Earthquake Fault zone or within the trace of any known active fault. The project would thus not be likely to cause direct human exposure to ground rupture, liquefaction, or strong ground shaking. Seismic hazards and potential adverse foundation conditions will be minimized by conformance with the recommended seismic design criteria of the CBC (CBC, 2001) Seismic Zone 4 requirements. The seismic requirements are further defined in Appendix 10B titled, “Structural Engineering Design Criteria.”

The plant structures and equipment and natural gas compressor station will be designed in accordance with CBC, Seismic Zone 4 requirements. Compliance with the CBC (2001), Seismic Zone 4 requirements will minimize the exposure of people to the risks associated with large seismic events. In addition, the major structures will be designed to withstand the strong ground motion of a design earthquake. A design earthquake is the postulated earthquake that is used for evaluating the earthquake resistance of a particular structure.

Because the seismic hazard in the region of the project area is relatively well defined, the design earthquake will be established by the maximum, or characteristic magnitude earthquake that can potentially occur on those faults as described above. While the exposure of people and property to geologic hazards may be a potentially significant impact, with the mitigation outlined below, such potential impact will be reduced to less than significant.

Because the project site is not located on a geological unit or soil that is unstable or that would become unstable as a result of the project, the potential for on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse is low and, therefore, the exposure of people and property to these types of geological hazards would constitute a significant impact.

Construction will require minor grading and excavation, thereby altering the terrain of the project site. Impacts on the geological conditions involve changes in drainage, cuts, and fills. Since the site is generally level, site grading is not expected to adversely impact the geological environment.

8.4.2.3 Geological Resources

Geological resources of commercial value (sand, gravel, clay mines, oil, gas or other commercial mineral resources) are not present within 2 miles of the project site. There are also no geological resources of recreational or scientific value near the project site. No significant impact to geological resources would thus occur with the project.

8.4.3 Cumulative Impacts

The project facilities will be constructed to the requirements of the CBC Seismic Zone 4. Site-specific geotechnical investigations will be performed before final design and construction. Construction and operation of the project will not cause significant adverse impacts in terms of geological hazards and resources and would also not cause any minor or less than significant impacts that could be considered significant cumulatively with effects of other nearby developments.

8.4.4 Mitigation Measures

Mitigation measures proposed for the project are as follows:

- Structures will be designed to meet seismic requirements of the 2001 CBC. Moreover, the design of plant structures and equipment will be in accordance with CBC, Seismic Zone 4 requirements to withstand the ground motion of a design earthquake. In addition, special design considerations will be made for constructed facilities, such as that for soil expansion potential as determined by the geotechnical investigation.
- A geotechnical engineer will be assigned to the project to carry out the duties required by the CBC to assess geologic conditions during construction and approve actual mitigation measures used to protect the facility from geologic hazards.

With the implementation of these mitigation measures, the SVEP will not result in significant direct, indirect, or cumulative geology-related impacts.

8.4.5 Laws, Ordinances, Regulations, and Standards

The LORS that apply to geologic hazards and resources are summarized in Table 8.4-1.

TABLE 8.4-1
Laws, Ordinances, Regulations, and Standards

Jurisdiction	Authority	Administering Agency	Compliance
Local	Uniform Building Code (UBC), 1997, Appendix Chapter 16, Division 4	County of Riverside	Acceptable design criteria for structures with respect to seismic design and load-bearing capacity
State	CBC, 2001	County of Riverside	Acceptable design criteria for structures with respect to seismic design and load-bearing capacity

8.4.6 Permits Required and Permit Schedule

The Uniform Building Code (UBC, 2001) specifies the acceptable design criteria for construction of facilities with respect to seismic design and load-bearing capacity. However, the California Building Standards Code (2001), which subsumes the CBC, incorporates the UBC by reference and contains additional requirements, and is the applicable code to be followed for the project. Compliance of building construction with UBC standards is covered under engineering and construction permits for the project (see Table 8.4-2 for a summary). There are no other permit requirements that specifically address geologic resources and hazards.

TABLE 8.4-2
Permits Required and Permit Schedule

Permit/Required Information	Schedule
Building Permit including Seismic Design Criteria: • Geotechnical/Geological Report • Requires structural, civil, electrical and mechanical plans • Identify geological hazards and conduct a seismic risk analysis	Submit application 30 days prior to start of construction.
Grading/Drainage/Erosion Control Permit: • Geotechnical/Geological Hazard Evaluation • Engineered Grading Plan • Topographic Plan • Drainage controls • Surface Hydrology Report • Erosion and Dust Control Plan	Submit application 30 days prior to start of construction activities.

8.4.7. Involved Agencies and Agency Contacts

No permits are required for compliance with geological LORS. However, the County of Riverside, Building and Safety Department, Engineering Division is responsible for enforcing compliance with building standards, including the CBC (Table 8.4-3).

TABLE 8.4-3
Permits Required and Permit Schedule

Issue	Contact/Agency	Title	Telephone
Building Permit	Brad Fagrell, County of Riverside Building and Safety Department Engineering Division	Engineering Division Manager	(951) 955 2000

8.4.8 References

California Division of Oil, Gas, and Geothermal Resources (CDOGGR). 2005. Oil and Gas Field Maps. http://www.consrv.ca.gov/dog.

Jennings, C. W. 1994. Fault Activity Map of California and Adjacent Areas. Division of Mines and Geology.

Morton. 1993. Geologic Map of the Romoland 7.5′ Quadrangle, Riverside County, California. By D. M. Morton (1991, 1995, and 1996) for the USGS.

Morton. 1996. Preliminary Geologic Map of the Perris 7.5′ Quadrangle, Riverside County, California. By D. M. Morton (1991, 1995, and 1996) for the USGS

Morton. 1996a. Preliminary Geologic Map of the Winchester 7.5′ Quadrangle, Riverside County, California. By D. M. Morton (1991, 1995-1999, and 2001) for the USGS.

Norris, R. M. and R. W. Webb. 1990. *Geology of California.* Second Edition. John Wiley and Sons. New York.

NRCS. 1971. Soil Survey Western Riverside Area, California. November.

URS Corporation. 2000. *Preliminary Geotechnical Investigation, Calpine Moreno Power Plant, Riverside County, California*. December. (Included as Appendix G of the Inland Empire Energy Center Application for Certification to the California Energy Commission).

CHJ, Inc. 2005. *Geotechnical Investigation. Romoland Energy Site*. Prepared for The Industrial Company. September.